

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
6 December 2001 (06.12.2001)

PCT

(10) International Publication Number
WO 01/91653 A2

(51) International Patent Classification⁷: **A61B 17/34**

(21) International Application Number: PCT/US01/14476

(22) International Filing Date: 3 May 2001 (03.05.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

09/580,615	30 May 2000 (30.05.2000)	US
09/580,616	30 May 2000 (30.05.2000)	US
09/580,721	30 May 2000 (30.05.2000)	US
09/580,693	30 May 2000 (30.05.2000)	US

(63) Related by continuation (CON) or continuation-in-part (CIP) to earlier applications:

US	09/580,615 (CON)
Filed on	30 May 2000 (30.05.2000)
US	09/580,616 (CON)
Filed on	30 May 2000 (30.05.2000)
US	09/580,721 (CON)
Filed on	30 May 2000 (30.05.2000)
US	09/580,693 (CON)
Filed on	30 May 2000 (30.05.2000)

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(81) Designated States (*national*): AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 01/91653 A2

(54) Title: TROCAR SYSTEM HAVING SHIELDED TROCAR, CANNULA WITH FINGER GRIPS, REMOVABLE END HOUSING AND FLEXIBLE VALVE SYSTEM, AND ASSOCIATED METHODS

(57) Abstract: A trocar system and associated methods are provided. The trocar system preferably has a cannula having an elongate cannula body. The cannula body includes medial and distal portions thereof having a first diameter and a proximal portion thereof connected to the medial portion and having a second diameter. The second diameter is preferably larger or greater than the first diameter. A cannula body end housing is readily detachably connected to the proximal portion of the cannula body for housing at least one valve therein. First and second trocar valves are positioned within the cannula body end housing and each having an opening in a medial portion thereof. The first valve is preferably positioned proximal of the second valve. A pair of finger grips are each connected to and extending outwardly from the proximal portion of the cannula body for gripping the cannula with the fingers of a hand of a user. A trocar or other instrument is positioned within the cannula body.

**TROCAR SYSTEM HAVING SHIELDED TROCAR, CANNULA WITH
FINGER GRIPS, REMOVABLE END HOUSING AND FLEXIBLE VALVE
SYSTEM, AND ASSOCIATED METHODS**

Field of the Invention

The present invention relates to the field of medical devices and, more particularly, to trocar systems and methods.

5

Background of the Invention

Trocar systems have been developed over the years for various endoscopic applications in the field of medicine. These trocar systems conventionally include a
10 cannula through which a trocar or obturator or other endoscopic related tool extends. The trocar can be shielded or unshielded. Examples of shielded trocars can be seen in U.S. Patent No. 4,654,030 by Moll et al. titled "Trocar," U.S. Patent No. 4,931,042 by Holmes et
15 al. titled "Trocar Assembly With Improved Latch," U.S. Patent No. 4,902,280 by Lander titled "Trocar," and U.S. Patent No. 5,030,206 by Lander titled "Trocar." Other shielded trocars which are more cost effective to manufacture, less bulky to handle and ship, and yet
20 produce reliable performance, however, are still needed.

It is also known to use one or more valves positioned within or connected to a proximal end of the

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cannula of a trocar system. Examples of such trocar systems having one or more valves in the cannula thereof can be seen in U.S. Patent No. 5,226,891 by Bushatz et al. titled "*Seal Protection Apparatus*," U.S. Patent No. 5,308,336 by Hart et al. titled "*Seal Protection Mechanism*," U.S. Patent No. 5,385,553 by Hart et al. titled "*Trocar With Floating Septum Seal*," U.S. Patent No. 5,782,812 by Hart et al. titled "*Seal Assembly For Access Device*," U.S. Patent No. 5,443,452 by Hart et al. titled "*Seal Assembly For Access Device*," and U.S. Patent No. 5,209,737 by Ritchart et al. titled "*Lever Actuated Septum Seal*."

These devices, however, often have complex mechanical valves which can be difficult and expensive to manufacture. Accordingly, after use in surgical procedures, e.g., endoscopic, the cannulas having the valves therein are often thrown away, especially if they are not sterilizable. Therefore, this expensive cost is often past on to insurance providers and patients whom upon whom they are used.

Others of these valves for cannulas of trocar systems do not have complex mechanical valves, but can still be expensive or more difficult to manufacture. As costs often rise in the health care industry, insurance, consumers, and governmental agencies often strive to drive prices for medical devices down. Also, these other valves are often not flexible for various uses by physicians or medical personnel during surgical procedures and often can be damaged. Accordingly, there is also still a need for alternative cannula and valve configurations for trocar systems, a need less expensive trocar systems, a need for more flexible trocar systems which enhance handling thereof by medical personnel

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users, i.e., physicians, and trocar systems which are still effective for various endoscopic surgical procedures.

Summary of the Invention

5 With the foregoing in mind, the present invention advantageously provides a trocar system having relatively low costs associated with the manufacturing of components of the system, e.g., cannula, trocar, valves, and thereby reduces the cost associated with the trocar
10 system. The present invention also advantageously provides a trocar system which enhances handling by physicians or medical personnel during surgical procedures. The present invention additionally advantageously provides a more flexible trocar system
15 which is effective during various endoscopic surgical procedures. The present invention still also advantageously provides a cannula and a trocar which each are more ergonomic and easy to use. The present invention further advantageously provides enhanced
20 methods of using and handling a trocar system during surgical procedures.

More particularly, a trocar system is provided which includes a cannula having an elongate cannula body, the cannula body having medial and distal portions
25 thereof having a first diameter and a proximal portion thereof connected to the medial portion and having a second diameter. The second diameter is preferably larger than the first diameter. The trocar system also preferably has a cannula body end housing readily
30 detachably connected to the proximal portion of the cannula body for housing at least one valve therein and first and second trocar valves positioned within the

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cannula body end housing and each having an opening in a medial portion thereof. The first valve preferably is positioned proximal of the second valve. A trocar having an elongate trocar body is positioned to extend through
5 the cannula body end housing, the first and second trocar valves, and the cannula body. The trocar also has a handle connected to the trocar body for gripping of and handling of the trocar by a hand of a user.

The first valve, for example, advantageously is
10 formed of an elastomeric material which deforms around a body of a trocar when positioned therein to seal outer peripheries of the trocar body abuttingly contacting inner peripheries of the opening of the first valve. The first valve also has a substantially planar proximal
15 surface and a substantially planar distal surface. The elastomeric material includes a fibrous material which is impregnated with a silicon material to enhance the strength of the valve and to enhance sliding and sealing of the body of the trocar.

The end housing of the cannula advantageously
20 allows the user to readily detach the end housing from the cannula without damage to a specimen which is being removed during a surgical procedure or other minimally invasive procedure. The first and second valves are
25 positioned within the end housing so that the specimen when withdrawn has little or no concern about damage or other contamination from the valves. When removal of a specimen is not needed, the first and second valves advantageously allow the user to maintain pressure within
30 the system and yet slidably move trocars or other instruments through the cannula.

Finger gripping means are connected to and extend outwardly from the proximal portion of the cannula

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body for gripping the cannula with the fingers of a hand of a user. The system also includes a trocar having an elongate trocar body for extending through the cannula. The trocar preferably also has a handle connected to the
5 trocar body for gripping of and handling of the trocar by a hand of a user.

The finger gripping means, for example, can be provided by a pair of finger grips. Each finger grip of the pair of finger grips has a finger support web. Each
10 of the support webs is connected at a position substantially 180 degrees from the other of the pair. This position and arrangement, for example, advantageously allows the cannula to be manipulated and comfortably handled by the user. Because the cannula is
15 preferably formed of a plastic disposable material, the support webs can easily be molded or manufactured in the same process as the forming of the cannula body. The finger grips are tactile and have a substantially ergonomic configuration.

20 A trocar having an elongate trocar body also extends through the cannula. The elongate trocar body has a sharpened distal end portion, a medial portion thereof having a first diameter, and a proximal portion having a second diameter. The second diameter is
25 preferably larger or greater than the first diameter. The trocar also has a handle connected to a proximal end portion of the trocar body for gripping of and handling of the trocar by a hand of a user and a shield slidably mounted to the medial portion of the trocar body and
30 biased in an extended position so that a distal end of the shield coveringly protects the sharpened distal end of the trocar body until pressure is applied thereagainst so that the shield slidably moves toward the proximal

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portion of the trocar body in a retracted position. The shield has a third diameter which is preferably at least equal to or less than the second diameter.

The present invention advantageously further
5 provides a method of handling a trocar system. The method preferably includes gripping a cannula with fingers of a hand of a user so that the fingers abuttingly contact at least one support web connected to and extending outwardly from a body of the cannula and
10 slidably positioning a trocar through the cannula body when being gripped by the fingers of the hand of the user.

A method of using a trocar preferably includes inserting a trocar through the body of a cannula,
15 retracting a shield of the trocar from a distal end portion of the trocar toward a proximal end portion of the trocar responsive to pressure on a distal end portion of the shield, and stopping the retracting of the shield by the use of a transition region between a medial
20 portion of the trocar and a proximal portion of the trocar.

Brief Description of the Drawings

Some of the features, advantages, and benefits of the present invention having been stated, others will
25 become apparent as the description proceeds when taken in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective environmental view of a trocar system positioned within a layer of epidermis of a patient according to the present invention;

30 FIG. 2 is a side elevational view of a trocar system according to the present invention;

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FIG. 3 is a fragmentary sectional view of a trocar system having primary and secondary valves taken along line 3-3 of FIG. 1 according to the present invention;

5 FIG. 4 is a fragmentary perspective view of a primary valve of a trocar system according to the present invention;

FIG. 5 is a sectional view of a primary valve of a trocar system taken along line 5-5 of FIG. 4
10 according to the present invention;

FIG. 6 is a fragmentary top plan view of a shielded obturator of a trocar system according to the present invention;

FIG. 7 is a top plan view of an obturator
15 removed from the shield of a shielded obturator of a trocar system according to the present invention;

FIG. 8 is a top plan view of a shield of a shielded obturator of a trocar system according to the present invention;

20 FIG. 9 is a perspective view of a secondary valve of a trocar system according to the present invention;

FIG. 10 is sectional view of a secondary valve of a trocar system taken along line 10-10 of FIG. 9
25 according to the present invention;

FIG. 11 is a top plan view of another embodiment of a primary valve of a trocar system according to the present invention;

FIG. 12 is a perspective view of another
30 embodiment of a primary valve of a trocar system according to the present invention;

FIG. 13 is a sectional view of another embodiment of a primary valve of a trocar system taken

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along line 13-13 of FIG. 11 according to the present invention;

FIG. 14 is an enlarged fragmentary side plan view of a shielded trocar of a trocar system according to the present invention; and

FIG. 15 is a sectional view of a shielded trocar of a trocar system taken along line 15-15 of FIG. 14 according to the present invention.

Detailed Description of Preferred Embodiments

The present invention will now be described more fully hereinafter with reference to the accompanying drawings which illustrate preferred embodiments of the invention. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout, the prime notation, if used, indicates similar elements in alternative embodiments.

FIG. 1 illustrates a trocar system 20 which preferably includes a cannula 30 having an elongate cannula body 31. The cannula body 31 includes distal 32 and medial 33 portions thereof having a first diameter and a proximal portion 34 thereof connected to the medial portion 33 and having a second diameter. The second diameter is preferably larger or greater than the first diameter as illustrated. The trocar system 20 also has finger gripping means 35 connected to and extending outwardly from the proximal portion 34 of the cannula body 31 for gripping the cannula 30 with the fingers F of

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a hand **H** of a user **U** and a trocar **40** having an elongate trocar body **41** for extending through the cannula **30**. The trocar **40** also has a handle **50** connected to the trocar body **41** for gripping of and handling of the trocar
5 **40** by a hand **H** of a user **U**.

As perhaps best shown in FIGS. 1-3, the finger gripping means **35** of the trocar system **20**, for example, can be provided by a pair of finger grips **36**, **37** connected to outer surfaces of the proximal portion of
10 the cannula body. Each of the pair of finger grips includes a finger support web **38**, **39** to thereby define a pair of finger support webs. Each of the pair of finger support webs **38**, **39** is connected at a position substantially 180 degrees from the other of the pair as
15 illustrated. The medial portion **33** of the cannula body **31** connects to the proximal portion **32** of the cannula body at an area defining a proximal transition region **25**. Each of the pair of support webs **38**, **39** has a distal peripheral surface **28**, **29** which extends outwardly from
20 the proximal portion **34** of the cannula body **31** and extends proximally from a plane substantially perpendicular to the transition region **25** of the cannula body **31**.

Also, each of the tactile finger support webs
25 **38**, **39** preferably has a roughened or ridged outer peripheral surface for reducing finger slippage when positioned on the finger support webs **38**, **39** (see FIG. 2). Each of the pair of finger support webs **38**, **39** are preferably formed integrally with the cannula body **31** as
30 a single piece. At least one of the pair of finger support webs **38** includes an auxiliary fluid port **22** extending through a medial portion of the fluid support

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web 38 to allow fluid, e.g., gas or liquid, to flow therethrough. A flow control valve 24, e.g., a stop flow or on/off flow valve which slidably extends across the port 22, is associated with the auxiliary fluid port 22 of the at least one 38 of the pair of finger support webs 38, 39 for controlling fluid flow, such as carbon dioxide, through the auxiliary fluid port 22 to the inner tubular portions of the cannula as illustrated.

Additionally, the medial portion 33 of the cannula body 31 includes a plurality of rib members 27 formed integrally with and extending outwardly from the outer surface of the cannula body 31. As understood by those skilled in the art, the rib members form fascia threads, but the medial portion can be smooth as well. The distal end portion 32 has peripheral cannula opening portions which are beveled and angle proximally from a first plane extending substantially perpendicular to a distal end of the distal portion of the cannula body 31 and extend along a second plane transverse to the first plane. The distal end portion, in essence, has distal bevel sheds forming a pre-peritoneal tent. The trocar body 41 of the trocar 40 has a sharpened distal end portion 42 and a shield 47 at least partially covering the distal end 42.

According to additional aspects of the present invention, a cannula body end housing 60 is readily detachably connected to the proximal portion 34 of the cannula body 31 for housing at least one valve therein. First and second trocar valves 62, 66 are either positioned substantially within or have portions positioned within the cannula body end housing 60 as illustrated, and each has an opening 63, 67 in a medial

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portion thereof. The first valve 62 is positioned proximal of the second valve 66 and is preferably positioned entirely within the housing 60 as shown. The trocar 40 has an elongate trocar body 41 which also
5 extends through the cannula body end housing 60, the respective openings 63, 67 of the first and second trocar valves, and the cannula body 31.

The first or primary valve 62 is preferably formed of an elastomeric material which slidably deforms
10 around the body of the trocar 40 when positioned therein to seal outer peripheries of the trocar body 41 abuttingly contacting inner peripheries of the opening 63 of the first valve 62. The first valve 62 has a substantially planar proximal surface 64 and a
15 substantially planar distal surface 65. In a first embodiment of the first or primary valve, the elastomeric material preferably includes a fibrous material being impregnated with a silicon material to enhance the strength of the valve 62 and to enhance sliding and
20 sealing of the body 41 of the trocar 40 (see FIGS. 4-5). In this embodiment, the fibrous material can also have accumulations or beads of silicon or other similar materials positioned around outer peripheries and/or around the opening 63 thereof. In a second or
25 alternative embodiment, the first or primary valve 62' is preferably formed of a Neoprene material as understood by those skilled in the art, e.g., Nylon and/or Lycra material, such as used in dive suits or other type of applications (see FIGS. 11-13). The Neoprene material
30 preferably has a closed-cell configuration and is laser cut for forming the valve. The first valve 62, 62' preferably has a stretching or elastic range to readily

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accomodate, e.g., auto-reduction, trocars or other instruments having a diameter of about 4 millimeters to about 13 millimeters as understood by those skilled in the art while still maintaining pneumoperitoneum. The
5 second valve 66 preferably has this range as well, but individually can even have a greater range, e.g., 0 mm to 13 or 14 mm. Accordingly, with the first and second valve 62, 66 in combination, the trocar system advantageously can receive different diameter instruments
10 without the necessity of switching cannulas or valve systems. Notably, the first valve 62, 62' is also preferably fixedly secured to the end housing, e.g., preferably by the outer peripheries thereof between lips, edges, or inwardly extending projections of portions of
15 the housing 60, to enhance guiding, sealing, and other performance criteria of the primary valve 62 in the trocar system.

The second valve 66 preferably has an annular flange portion 71 for enhancing positioning of the second
20 valve 66 within the end housing 60, annular-shaped sidewalls 68 connected to the annular flange and extending distally when positioned in the end housing, and at least a pair of valve flaps 69 connected to and extending inwardly from the sidewalls 68 and/or flange
25 portion 71. The sidewalls, for example, can extend distally of the end housing so that the flange portion 71 retains only portions of the valve within the end housing and yet slidably or in a spaced-apart relation have other portions which are positioned within the proximal portion
30 of the cannula body. The pair of valve flaps 69 have at least one slit along common peripheral edges thereof through which the trocar body 41 extends. The second

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valve 66 also preferably has ribs or rib members connected to, e.g., formed integrally therewith as a single piece, the sidewalls 68 as illustrated to reduce drag as will be understood by those skilled in the art.

- 5 The second valve is also preferably impregnated with a lubricant such as an oil material to enhance performance of the valve.

The end housing 60 has a substantially annular shape, has a first opening 58 at a proximal end, and has
10 a second opening 59 at a distal end. The first valve 62 is positioned adjacent the first opening 58, and the second valve is positioned spaced-apart from the first valve 62 and adjacent the second opening 59. The outer surface of the end housing 60 is roughened to enhance
15 gripping and rotating thereof by a hand of a user when readily detaching the end housing 60 from the proximal portion of the cannula body 31. The proximal end portion of the cannula body 31 has at least one end housing mating portion 26 associated therewith and the end
20 housing 60 also has at least one cannula body mating portion 27 associated therewith so that the end housing 60 matingly attaches to the cannula body 31 in a secured position and whereby movement of the end housing 60, e.g., rotational, by a hand of a user releases, e.g.,
25 unsecures or unlocks, the respective mating portions 26, 27 for ready removal of the end housing 60 by the user with the first and second valves 62, 66 positioned therein and so that specimens, e.g., tissue, can be readily removed from the cannula body 31 without damage
30 by the first and second valves 62, 66. The cannula body 31 is preferably formed of a clear plastic material so that direct visualization of specimen removal and

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instrument passage can be advantageously provided. This, for example, allows various types of cutting, gripping, or other types of tools to be inserted through the cannula 30 for various endoscopic procedures.

5 According to yet another aspect of the present invention, the trocar 40, or spike or obturator if used as well, of the trocar system 20 preferably has an elongate trocar body 41 for extending through the cannula 30. The elongate trocar body 41 has a sharpened distal
10 end portion 42, a medial portion 43 thereof having a first diameter, and a proximal portion 44 having a second diameter. The second diameter is preferably larger or greater than the first diameter. The trocar 40 also has a handle 50 connected to a proximal end portion 44 of the
15 trocar body 41 for gripping of and handling of the trocar 40 by a hand H of a user U and a shield 45 slidably mounted to the medial portion 43 of the trocar body 41 and biased in an extended position so that a distal end 46 of the shield 45 coveringly protects the sharpened
20 distal end 42 of the trocar body 41 until pressure is applied thereagainst so that the shield 45 slidably moves toward the proximal portion 44 of the trocar body 41 in a retracted position. The shield 45 preferably has a third diameter which is at least equal to or less than
25 the second diameter as illustrated.

 The shield 45 has a tubular-shaped shield body 47 that substantially surrounds the medial portion 43 of the trocar body 41 and biasing means, e.g., provided by a spring 48 or other biasing member, positioned between
30 an outer surface of the medial portion 43 of the trocar body 41 and an inner surface of the tubular-shaped shield body 47. The trocar body 41 preferably includes a trocar

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body transition region having an outer surface extending outwardly from the medial portion 43 to the proximal portion 44 and defining a shield stop 49 when the shield 45 is biased to the retracted position. The shield stop 49 is preferably a first shield stop, and a second shield stop 46, such as provided by a rod or pin member can also or alternatively be connected to the trocar body 41 and cooperates with the shield body 47, e.g., to through a slot formed therein, to provide an alternative or an auxiliary stop for the shield body 47 when moving to the retracted position.

The sharpened distal end portion 42, e.g., preferably having a pyramidal tip, of the trocar 40 preferably has a fourth diameter. The fourth diameter is preferably larger than the first diameter of the medial portion 43 of the trocar body 41. The shield body 47 also preferably has a beveled distal end which corresponds to the shape and position of the sharpened distal end portion and which extends beyond a distal end of the sharpened distal end portion 42 of the trocar body 41. This shield body can, for example, have a protruding section as illustrated or have other shaped protruding section, e.g., a nosed or other tip with which contact allows the shield body to retract and yet not significantly damage the object, tissue or other item to which it abuttingly contacts.

As illustrated in FIGS. 1-13, the present invention also includes a method of handling a trocar system 20. The method includes gripping a cannula 30 with fingers F of a hand H of a user U so that the fingers F abuttingly contact at least one support web 38, 39 connected to and extending outwardly from a body 31 of

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the cannula 30 and slidably positioning a trocar 40 through the cannula body 31 when being gripped by the fingers F of the hand H of the user U.

The present invention also includes a method of using a trocar system 20 having the steps of detaching a cannula end housing 60 from a proximal end portion of a cannula body and removing tissue or other specimen as understood by those skilled in the art from the cannula body 31. The method can also include the end housing 60 having at least one valve 62, 66 positioned therein. The cannula end housing 60 and the cannula body 31 each have a substantially annular shape, and the cannula body 31 has a medial portion 33 having a first diameter and a proximal portion 34 connected to the medial portion 33 and having a second diameter. The second diameter is preferably larger or greater than the first diameter. The method can further include the detaching step including rotating the cannula end housing 60 a preselected rotational direction, e.g., counter-clockwise, and the at least one valve 62, 66 including a first and a second valve 62, 66 each connected to the cannula end housing 60 (see FIGS. 3-5 and 9-13).

Additionally, the present invention can include a method of using a trocar 40. The method preferably has the steps of inserting a trocar 40 through the body 31 of a cannula 30, retracting a shield 45 of the trocar 40 from a distal end portion 42 of the trocar 40 toward a proximal end portion 44 of the trocar 40 responsive to pressure on a distal end portion 46 of the shield 45, and stopping the retracting of the shield 45 by the use of a transition region between a medial portion of the trocar and a proximal portion of the trocar or by the use of

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another stop member. The method can also include the trocar 40 having a handle 50 connected to a proximal portion 44 thereof, the handle 50 has a thumb rest 53 positioned on an outer surface thereof, and the step of
5 inserting preferably includes pressing the thumb of a user on the thumb rest 53 of the handle 50 when passing through the cannula body 31.

In the drawings and specification, there have been disclosed a typical preferred embodiment of the
10 invention, and although specific terms are employed, the terms are used in a descriptive sense only and not for purposes of limitation. The invention has been described in considerable detail with specific reference to these illustrated embodiments. It will be apparent, however,
15 that various modifications and changes can be made within the spirit and scope of the invention as described in the foregoing specification and as defined in the appended claims.

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THAT CLAIMED IS:

1. A trocar system comprising:

a cannula having an elongate cannula body, the cannula body including medial and distal portions thereof having a first diameter and a proximal portion thereof
5 connected to the medial portion and having a second diameter, the second diameter being larger than the first diameter;

finger gripping means connected to and
extending outwardly from the proximal portion of the
10 cannula body for gripping the cannula with the fingers of a hand of a user; and

a trocar having an elongate trocar body for
extending through the cannula, the trocar also having a
handle connected to the trocar body for gripping of and
15 handling of the trocar by a hand of a user.

2. A trocar system as defined in Claim 1,
wherein said finger gripping means includes at least a
pair of finger grips connected to outer surfaces of the
proximal portion of the cannula body, each of the pair of
5 finger grips comprising a finger support web to thereby
define a pair of finger support webs, and wherein each of
the pair of finger support webs is connected at a
position substantially 180 degrees from the other of the
pair.

3. A trocar system as defined in Claim 1,
wherein the medial portion of the cannula body connects
to the proximal portion of the cannula body at an area
defining a proximal transition region, wherein each of
5 the pair of support webs has a distal peripheral surface
which extends outwardly from the proximal portion of the

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cannula body and extends proximally from a plane substantially perpendicular to the transition region of the cannula body.

4. A trocar system as defined in Claim 2, wherein each of the finger support webs have a roughened outer peripheral surface for reducing finger slippage when positioned on the finger support webs.

5. A trocar system as defined in Claim 2, wherein each of the pair of finger support webs are formed integrally with the cannula body as a single piece.

6. A trocar system as defined in Claim 2, wherein at least one of the pair of finger support webs includes an auxiliary fluid port extending through a medial portion of the fluid support web.

7. A trocar system as defined in Claim 6, further comprising a flow control valve associated with the auxiliary fluid port of the at least one of the pair of finger support webs for controlling fluid flow through
5 the auxiliary fluid port.

8. A trocar system as defined in Claim 1, wherein the medial portion of the cannula body including a plurality of rib members formed integrally with and extending outwardly from the outer surface of the cannula
5 body.

9. A trocar system as defined in Claim 1, wherein the distal end portion has peripheral cannula

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opening portions which angle proximally from a first plane extending substantially perpendicular to a distal end of the distal portion of the cannula body and extend along a second plane transverse to the first plane.

10. A trocar system as defined in Claim 9, wherein the trocar body of said trocar has a sharpened distal end and a shield at least partially covering the distal end.

11. A cannula comprising:
an elongate cannula body, the cannula body including medial and distal portions thereof having a first diameter and a proximal portion thereof connected to the medial portion and having a second diameter, the second diameter being larger than the first diameter; and
finger gripping means connected to and extending outwardly from the proximal portion of the cannula body for gripping the cannula with the fingers of a hand of a user.

12. A cannula as defined in Claim 11, wherein said finger gripping means includes a pair of finger grips connected to outer surfaces of the proximal portion of the cannula body, each of the pair of finger grips comprising a finger support web to thereby define a pair of finger support webs, and wherein each of the pair of finger support webs is connected at a position substantially 180 degrees from the other of the pair.

13. A cannula as defined in Claim 12, wherein the medial portion of the cannula body connects to the proximal portion of the cannula body at an area defining

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a proximal transition region, wherein each of the pair of
5 support webs has a distal peripheral surface which
extends outwardly from the proximal portion of the
cannula body and extends proximally from a plane
substantially perpendicular to the transition region of
the cannula body.

14. A cannula as defined in Claim 13, wherein
each of the finger support webs have a roughened outer
peripheral surface for reducing finger slippage when
positioned on the finger support webs.

15. A cannula as defined in Claim 12, wherein
each of the pair of finger support webs are formed
integrally with the cannula body as a single piece.

16. A cannula as defined in Claim 15, wherein
at least one of the pair of finger support webs includes
an auxiliary fluid port extending through a medial
portion of the fluid support web.

17. A cannula as defined in Claim 16, further
comprising a flow control valve associated with the
auxiliary fluid port of the at least one of the pair of
finger support webs for controlling fluid flow through
5 the auxiliary fluid port.

18. A cannula as defined in Claim 17, wherein
the medial portion of the cannula body including a
plurality of rib members formed integrally with and
extending outwardly from the outer surface of the cannula
5 body.

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19. A cannula as defined in Claim 18, wherein the distal end portion has peripheral cannula opening portions which angle proximally from a first plane extending substantially perpendicular to a distal end of the distal portion of the cannula body and extend along a second plane transverse to the first plane.

20. A cannula comprising:
an elongate cannula body, the cannula body including medial and distal portions thereof having a first diameter and a proximal portion thereof connected to the medial portion and having a second diameter, the second diameter being larger than the first diameter; and
at least a pair of finger grips connected to and extending outwardly from the proximal portion of the cannula body to grip the cannula with the fingers of a hand of a user.

21. A trocar system comprising:
a cannula having an elongate cannula body, the cannula body including medial and distal portions thereof having a first diameter and a proximal portion thereof connected to the medial portion and having a second diameter, the second diameter being larger than the first diameter;

a cannula body end housing readily detachably connected to the proximal portion of the cannula body for housing at least one valve therein;

first and second trocar valves positioned within the cannula body end housing and each having an opening in a medial portion thereof, the first valve being positioned proximal of the second valve; and

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25 a trocar having an elongate trocar body
extending through the cannula body end housing, the first
and second trocar valves, and the cannula body, the
trocar also having a handle connected to the trocar body
for gripping of and handling of the trocar by a hand of
30 a user.

22. A trocar system as defined in Claim 21,
wherein the first valve is formed of an elastomeric
material which deforms around the body of the trocar when
positioned therein to seal outer peripheries of the
5 trocar body abuttingly contacting inner peripheries of
the opening of the first valve.

23. A trocar system as defined in Claim 22,
wherein the first valve has a substantially planar
proximal surface and a substantially planar distal
surface, and wherein outer peripheries of the first valve
5 are fixedly attached to the end housing.

24. A trocar system as defined in Claim 23,
wherein the elastomeric material includes a fibrous
material impregnated with a silicon material to enhance
the strength of the valve and to enhance sliding and
5 sealing of the body of the trocar.

25. A trocar system as defined in Claim 23,
wherein the second valve has an annular flange portion
for enhancing positioning of the second valve within the
end housing, annular-shaped sidewalls connected to the
annular flange and extending distally when positioned in
5 the end housing, and at least a pair of valve flaps
connected to and extending inwardly from the sidewalls,

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the pair of valve flaps having at least one slit along
common peripheral edges thereof through which the trocar
10 body extends.

26. A trocar system as defined in Claim 25,
wherein the sidewalls of the second valve have at least
one rib member connected thereto, and wherein the second
valve is formed of a silicon material and is impregnated
5 with an oil material for lubrication thereof.

27. A trocar system as defined in Claim 21,
wherein the end housing has a substantially annular
shape, has a first opening at a proximal end, and has a
second opening at a distal end, the first valve being
5 positioned adjacent the first opening and the second
valve being positioned adjacent the second opening.

28. A trocar system as defined in Claim 27,
wherein the outer surface of the end housing is roughened
to enhance gripping and rotating thereof by a hand of a
user when readily detaching the end housing from the
5 proximal portion of the cannula body.

29. A trocar system as defined in Claim 27,
wherein the proximal end portion of the cannula body has
at least one end housing mating portion associated
therewith and the end housing also has at least one
5 cannula body mating portion associated therewith so that
the end housing matingly attaches to the cannula body in
a secured position and whereby movement of the end
housing by a hand of a user releases the respective
mating portions for ready removal of the end housing by
10 the user with the first and second valves positioned

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therein and so that specimens can be readily removed from the cannula body without damage by the first and second valves.

30. A cannula system comprising:

a cannula having an elongate cannula body, the cannula body including medial and distal portions thereof having a first diameter and a proximal portion thereof
5 connected to the medial portion and having a second diameter, the second diameter being larger than the first diameter; and

a cannula body end housing readily detachably connected to the proximal portion of the cannula body for
10 housing at least one valve therein.

31. A cannula system as defined in Claim 30, further comprising first and second trocar valves positioned within the cannula body end housing and each having an opening in a medial portion thereof, the first
5 valve being positioned proximal of the second valve.

32. A cannula system as defined in Claim 31, wherein the first valve is formed of an elastomeric material which deforms around a body of a trocar when positioned therein to seal outer peripheries of the
5 trocar body abuttingly contacting inner peripheries of the opening of the first valve.

33. A cannula system as defined in Claim 32, wherein the first valve has a substantially planar proximal surface and a substantially planar distal surface, and wherein outer peripheries of the first valve
5 are fixedly attached to the end housing.

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34. A cannula system as defined in Claim 32, wherein the elastomeric material includes a fibrous material impregnated with a silicon material to enhance the strength of the valve and to enhance sliding and
10 sealing of the body of the trocar.

35. A cannula system as defined in Claim 33, wherein the second valve has an annular flange portion for enhancing positioning of the second valve within the end housing, annular-shaped sidewalls connected to the
5 annular flange and extending distally when positioned in the end housing, and at least a pair of valve flaps connected to and extending inwardly from the sidewalls, the pair of valve flaps having at least one slit along common peripheral edges thereof through which a trocar
10 body is capable of readily extending.

36. A cannula system as defined in Claim 35, wherein the sidewalls of the second valve have at least one rib member connected thereto, and wherein the second valve is formed of a silicon material and is impregnated
5 with an oil material for lubrication thereof.

37. A cannula system as defined in Claim 31, wherein the end housing has a substantially annular shape, has a first opening at a proximal end, and has a second opening at a distal end, the first valve being
5 positioned adjacent the first opening and the second valve being positioned adjacent the second opening.

38. A cannula system as defined in Claim 30, wherein the outer surface of the end housing is roughened to enhance gripping and rotating thereof by a hand of a

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user when readily detaching the end housing from the
5 proximal portion of the cannula body.

39. A cannula system as defined in Claim 30,
wherein the proximal end portion of the cannula body has
at least one end housing mating portion associated
therewith and the end housing also has at least one
5 cannula body mating portion associated therewith so that
the end housing matingly attaches to the cannula body in
a secured position and whereby movement of the end
housing by a hand of a user releases the respective
mating portions for ready removal of the end housing by
10 the user so that specimens can be readily removed from
the cannula body without damage by the first and second
valves.

40. A trocar system comprising:

a cannula having an elongate cannula body, the
cannula body including medial and distal portions thereof
having a first diameter and a proximal portion thereof
connected to the medial portion and having a second
diameter, the second diameter being larger than the first
diameter; and

a trocar having an elongate trocar body for
extending through the cannula, the elongate trocar body
having a sharpened distal end portion, a medial portion
thereof having a first diameter, and a proximal portion
having a second diameter, the second diameter being
larger than the first diameter, the trocar also having a
handle connected to a proximal end portion of the trocar
body for gripping of and handling of the trocar by a hand
of a user and a shield slidably mounted to the medial
portion of the trocar body and biased in an extended

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position so that a distal end of the shield coveringly protects the sharpened distal end of the trocar body until pressure is applied thereagainst so that the shield slidably moves toward the proximal portion of the trocar body in a retracted position, the shield having a third diameter, the third diameter being at least equal to or less than the second diameter.

41. A trocar system as defined in Claim 40, wherein the shield has a tubular-shaped shield body that substantially surrounds the medial portion of the trocar body and biasing means positioned between an outer
5 surface of the medial portion of the trocar body and an inner surface of the tubular-shaped shield body.

42. A trocar system as defined in Claim 41, wherein the trocar body includes a trocar body transition region, the transition region having an outer surface extending outwardly from the medial portion to the
5 proximal portion and defining a shield stop when the shield is biased to the retracted position.

43. A trocar system as defined in Claim 42, wherein the shield stop comprises a first shield stop, and wherein a second shield stop is connected to the trocar body and cooperates with the shield body to
5 provide an alternative or an auxiliary stop for the shield body when moving to the retracted position.

44. A trocar system as defined in Claim 43, wherein the sharpened distal end portion has a fourth diameter, the fourth diameter being larger than the first diameter of the medial portion of the trocar body.

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45. A trocar system as defined in Claim 44, wherein the shield body has a distal end which extends beyond a distal end of the sharpened distal end portion of the trocar body.

46. A trocar comprising:

an elongate trocar body for extending through the cannula, the elongate trocar body having a sharpened distal end portion, a medial portion thereof having a
5 first diameter, and a proximal portion having a second diameter, the second diameter being larger than the first diameter;

a handle connected to a proximal end portion of the trocar body for gripping of and handling of the
10 trocar by a hand of a user; and

a shield slidably mounted to the medial portion of the trocar body and biased in an extended position so that a distal end of the shield coveringly protects the sharpened distal end of the trocar body until pressure is
15 applied thereagainst so that the shield slidably moves toward the proximal portion of the trocar body in a retracted position, the shield having a third diameter, the third diameter being at least equal to or less than the second diameter.

47. A trocar as defined in Claim 46, wherein the shield has a tubular-shaped shield body that substantially surrounds the medial portion of the trocar body and biasing means positioned between an outer
5 surface of the medial portion of the trocar body and an inner surface of the tubular-shaped shield body.

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48. A trocar as defined in Claim 47, wherein the trocar body includes a trocar body transition region, the transition region having an outer surface extending outwardly from the medial portion to the proximal portion and defining a shield stop when the shield is biased to the retracted position.

49. A trocar as defined in Claim 48, wherein the shield stop comprises a first shield stop, and wherein a second shield stop is connected to the trocar body and cooperates with the shield body to provide an alternative or an auxiliary stop for the shield body when moving to the retracted position.

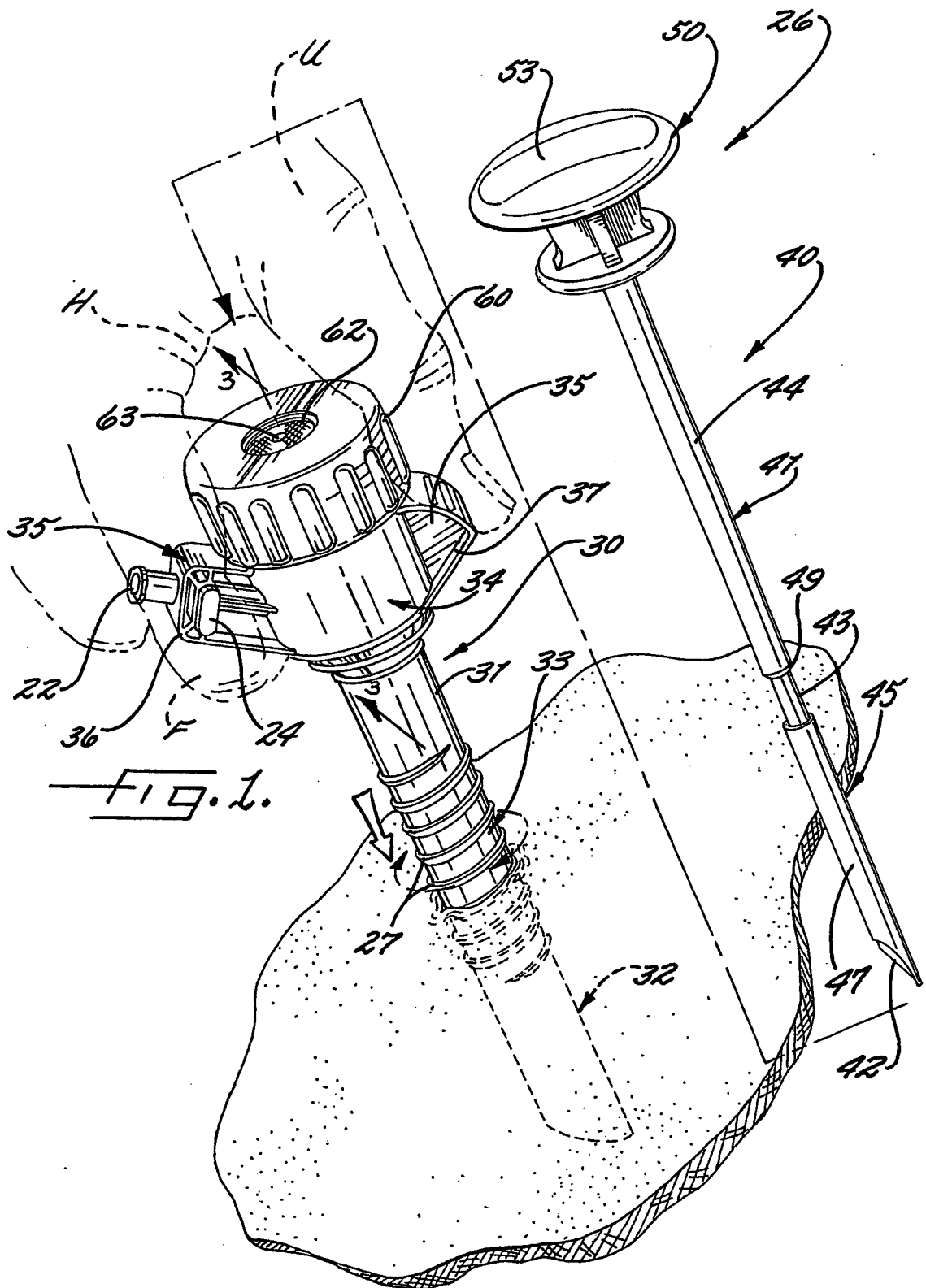
50. A trocar as defined in Claim 49, wherein the sharpened distal end portion has a fourth diameter, the fourth diameter being larger than the first diameter of the medial portion of the trocar body.

51. A trocar as defined in Claim 50, wherein the shield body has a distal end which extends beyond a distal end of the sharpened distal end portion of the trocar body.

52. A method of handling a trocar system, the method comprising the steps of:

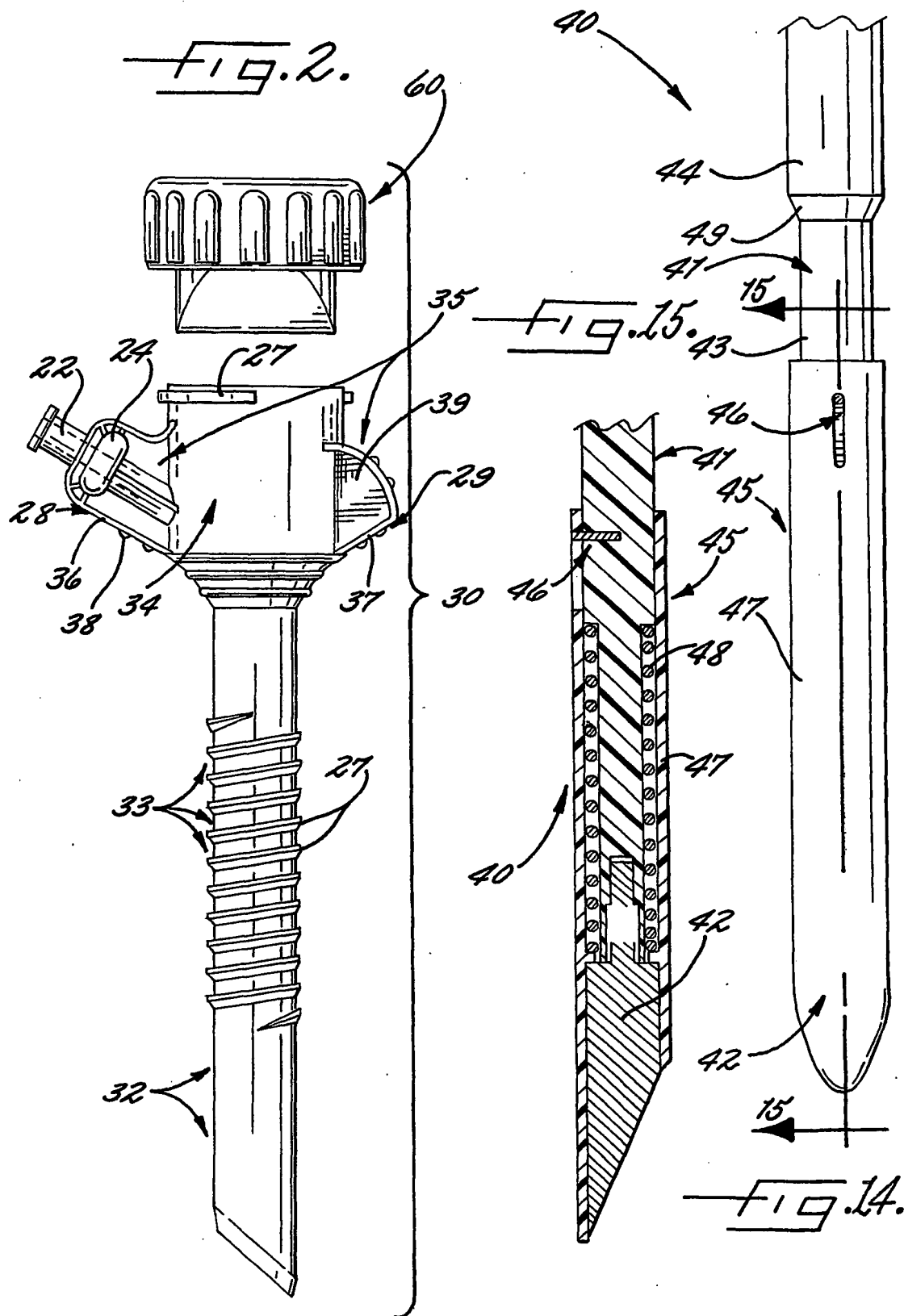
gripping a cannula with fingers of a hand of a user so that the fingers abuttingly contact at least one support web connected to and extending outwardly from a body of the cannula; and

slidably positioning a trocar through the cannula body when being gripped by the fingers of the hand of the user.



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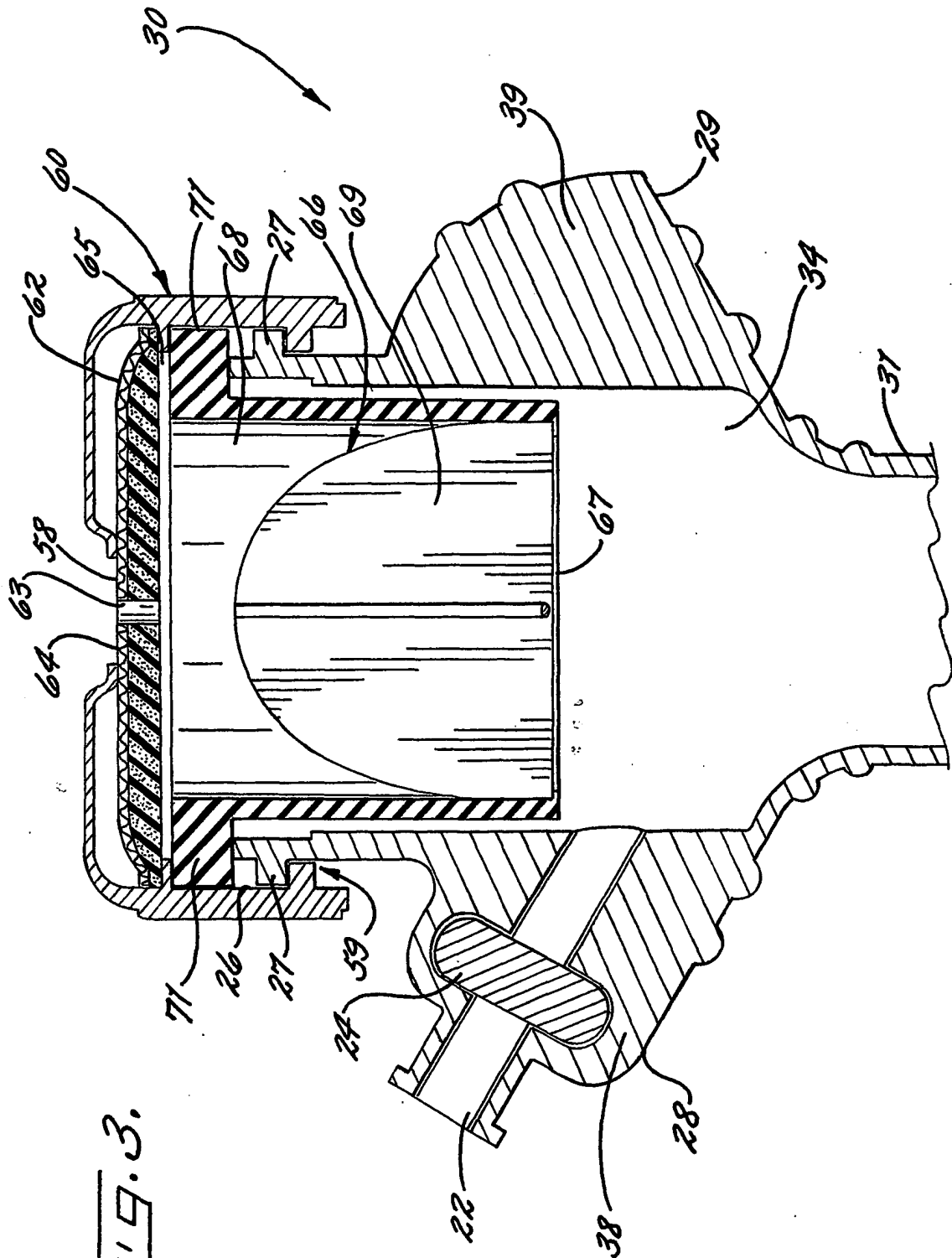


FIG. 3.

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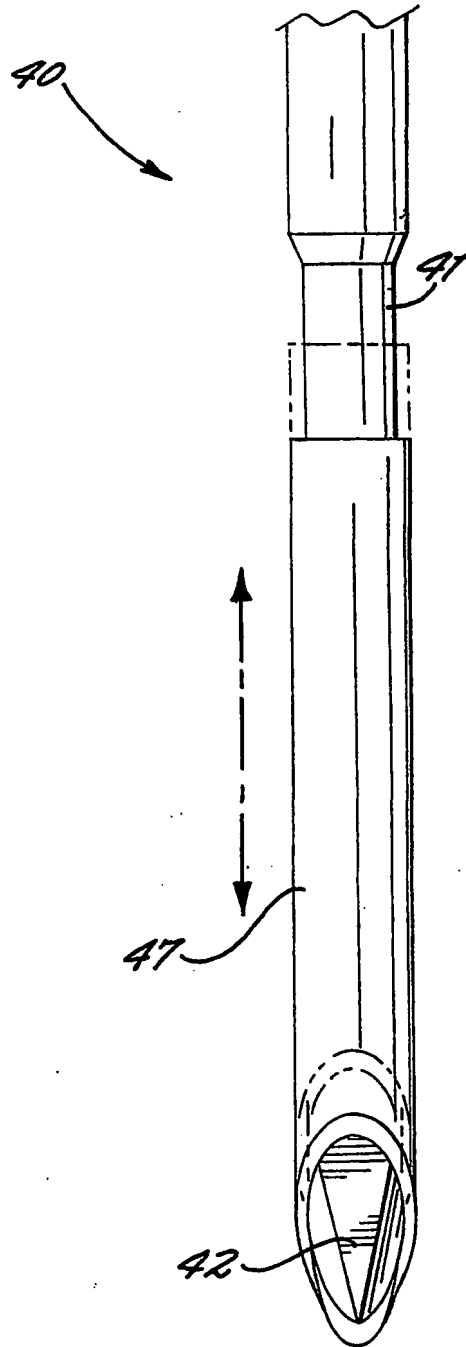
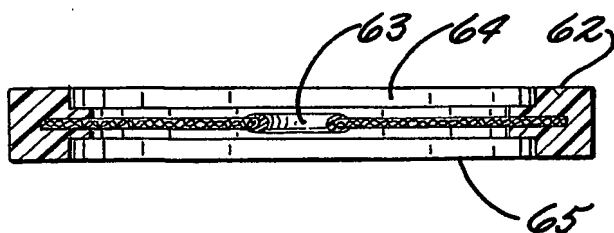
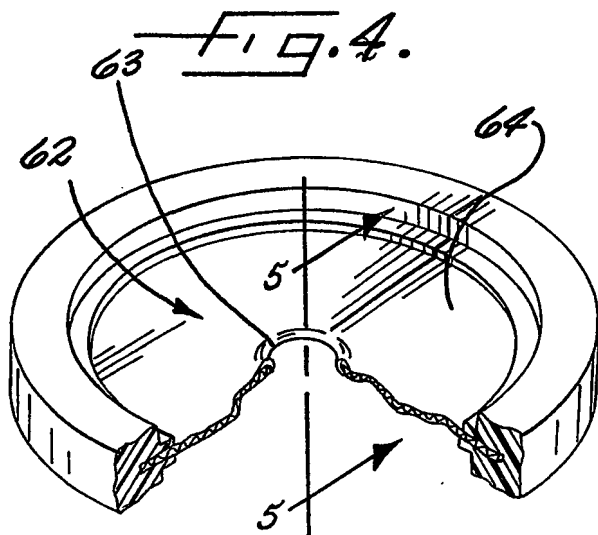


FIG. 6.

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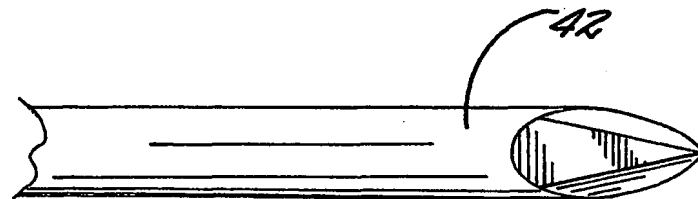
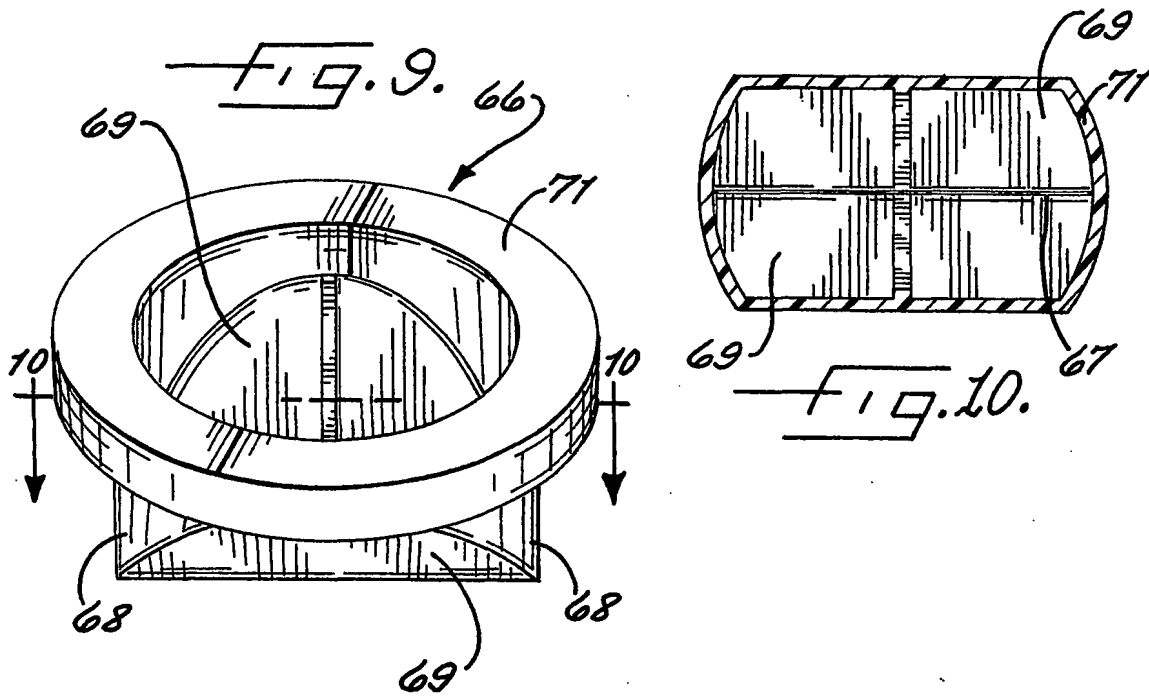


Fig. 7.

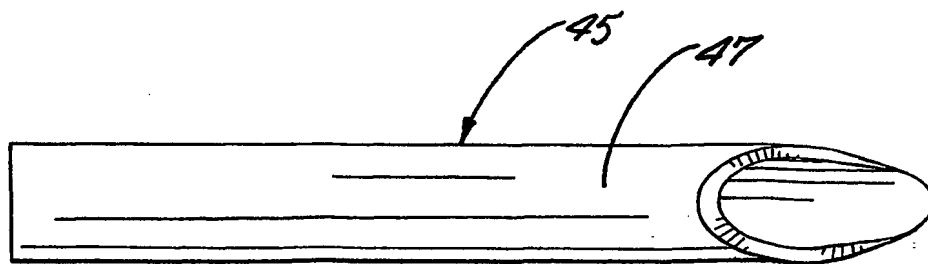
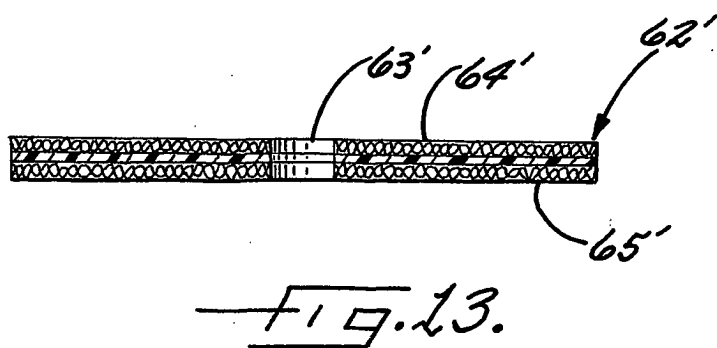
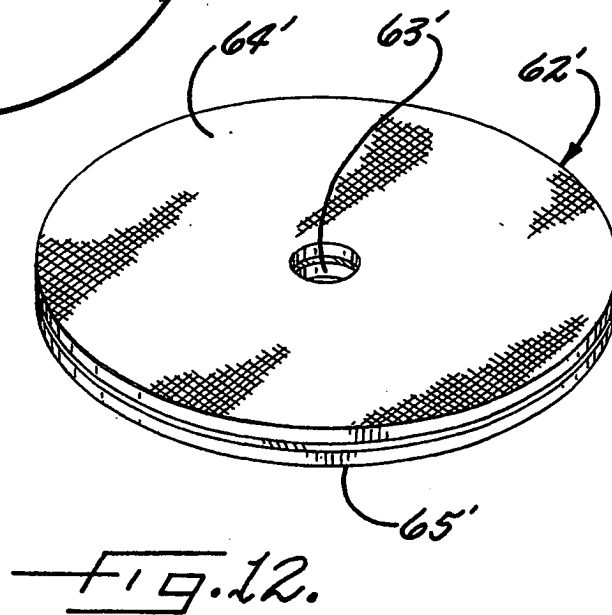
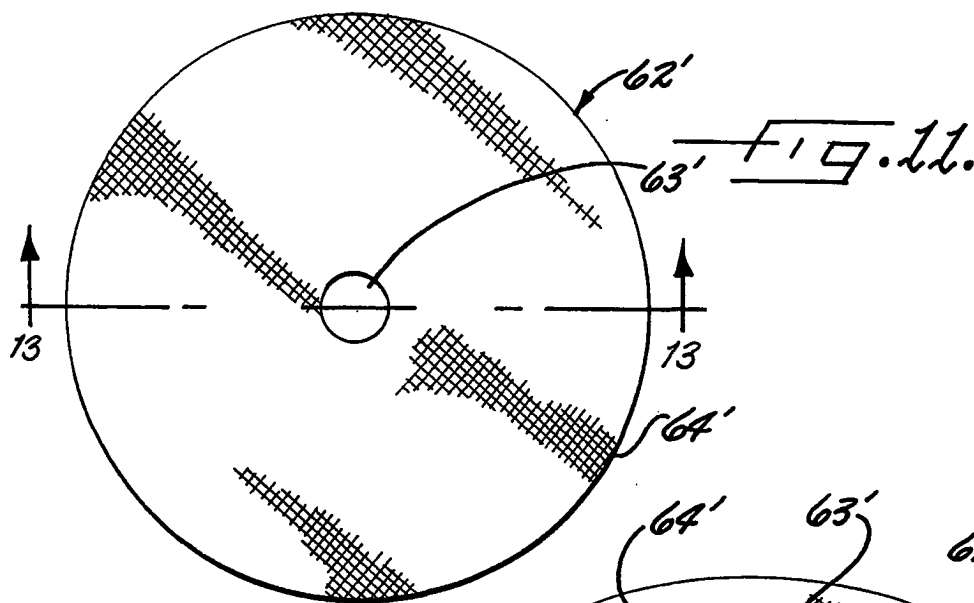


Fig. 8.

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(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
6 December 2001 (06.12.2001)

PCT

(10) International Publication Number
WO 01/91653 A3

(51) International Patent Classification⁷: **A61B 17/34**

US 09/580.721 (CON)

(21) International Application Number: PCT/US01/14476

Filed on 30 May 2000 (30.05.2000)

(22) International Filing Date: 3 May 2001 (03.05.2001)

US 09/580.693 (CON)

Filed on 30 May 2000 (30.05.2000)

(25) Filing Language: English

(71) Applicant (for all designated States except US): **GENI-CON LC** [US/US]; 573 Waterscape Way, Orlando, FL 32828 (US).

(26) Publication Language: English

(30) Priority Data:

09/580.615 30 May 2000 (30.05.2000) US

09/580.616 30 May 2000 (30.05.2000) US

09/580.721 30 May 2000 (30.05.2000) US

09/580.693 30 May 2000 (30.05.2000) US

(63) Related by continuation (CON) or continuation-in-part (CIP) to earlier applications:

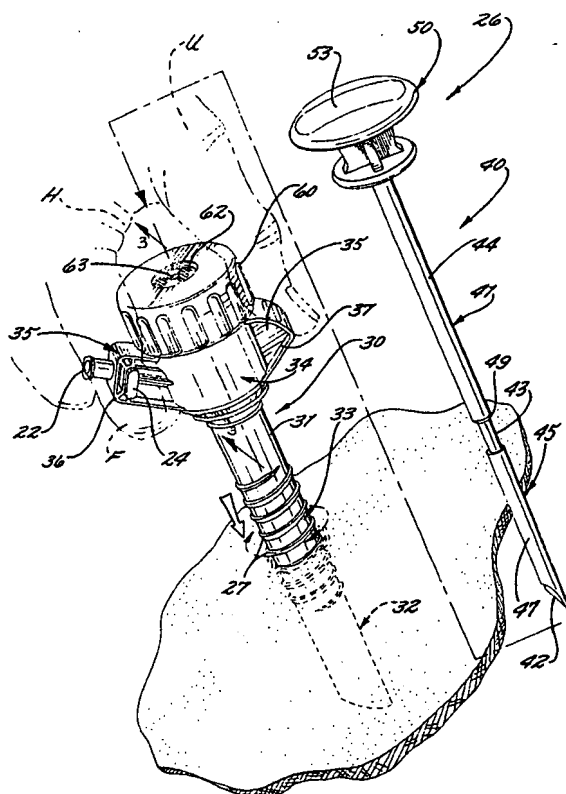
US 09/580.616 (CON)

Filed on 30 May 2000 (30.05.2000)

(72) Inventors: **HABERLAND, Gary, W.**; 573 Waterscape Way, Orlando, FL 32828 (US). **MARCHAND, Sam, R.**; 1170 Rohmar Rd., Dunedin, FL 34698 (US). **NILSON, Steve**; 2170 Southeast 38th Street, Ocala, FL 34480 (US). **HAGEN, Robert, Sean**; 413 S. Lakemont Ave., Winter Park, FL 32792 (US). **GLADDISH, Bennie, W., Jr.**; 10521 Lake Williams Dr., Odessa, FL 33556 (US).

[Continued on next page]

(54) Title: TROCAR SYSTEM



(57) Abstract: A trocar system and associated methods are provided. The trocar system (20) preferably has a cannula (30) having an elongate cannula body (31). The cannula body (31) includes medial (33) and distal (32) portions thereof having a first diameter and a proximal portion (34) thereof connected to the medial portion (33) and having a second diameter. The second diameter is preferably larger or greater than the first diameter. A cannula-body end housing (60) is readily detachably connected to the proximal portion (34) of the cannula body (31) for housing at least one valve therein. First and second trocar valves (62, 66) are positioned within the cannula body end housing (60) and each having an opening (63, 67) in a medial portion thereof. The first valve (62) is preferably positioned proximal of the second valve (66). A pair of finger grips (35) are each connected to and extending outwardly from the proximal portion (34) of the cannula body (31) for gripping the cannula (30) with the fingers (F) of a hand (H) of a user (U). A trocar (40) or other instrument is positioned within the cannula body (31).

WO 01/91653 A3



(74) Agent: WHITTLE, Jeffrey, S.: Allen, Dyer, Doppelt, Milbrath & Gilchrist, P.A., Suite 1401, 255 S. Orange Avenue, P. O. Box 3791, Orlando, FL 32802-3791 (US).

IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

(81) Designated States (national): AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(88) Date of publication of the international search report:

16 May 2002

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE,

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 01/14476

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61B17/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 617 924 A (ETHICON, INC.) 5 October 1994 (1994-10-05) abstract; figures column 7, line 46-50 ---	1-3,5, 9-13,15, 20
X	US 4 601 710 A (MOLL) 22 July 1986 (1986-07-22) abstract; figures column 3, line 18-22 ---	1-3,5, 9-13,15, 20
X	US 5 980 493 A (SMITH ET AL.) 9 November 1999 (1999-11-09) abstract; figures column 10, line 26-51 ---	1-5, 10-15,20
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Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

6 March 2002

Date of mailing of the international search report

13.03.02

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 01/14476

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 792 112 A (HART ET AL.) 11 August 1998 (1998-08-11) abstract; figures column 5, line 21 -column 6, line 50 ---	1,8,11, 20
A	US 5 496 289 A (WENSTROM, JR.) 5 March 1996 (1996-03-05) the whole document ---	1,11,20
X	US 5 662 615 A (BLAKE, III) 2 September 1997 (1997-09-02) abstract; figures ---	21-23, 25, 27-33, 35,37-39
X	US 5 584 850 A (HART ET AL.) 17 December 1996 (1996-12-17) abstract; figures ---	21-23, 25-27, 30-33, 35-37
X	WO 98 53865 A (UNITED STATES SURGICAL CORPORATION) 3 December 1998 (1998-12-03) abstract; figures page 8, line 24 -page 10, line 11 ---	21-24, 30-34
X	US 5 613 954 A (NELSON ET AL.) 25 March 1997 (1997-03-25) abstract; figures 3-5 column 3, line 25 -column 4, line 14 ---	21-23, 30-33
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A	DE 91 01 109 U (EFFNER GMBH) 27 February 1992 (1992-02-27) figures -----	40-51

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 01/14476

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.: 52
because they relate to subject matter not required to be searched by this Authority, namely:
Rule 39.1(iv) PCT - Method for treatment of the human or animal body by surgery
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-20

Cannula having finger gripping means

2. Claims: 21-39

Valve system for cannula assembly

3. Claims: 40-51

Trocar having an automatically retractable safety shield

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 01/14476

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